Re: Ive got this problem with AC through capacitors (phase lag)

Source: http://sci.tech−archive.net/Archive/sci.electronics.basics/2004−11/0526.html

---

From: Joel Kolstad (*JKolstad71HatesSpam_at_Yahoo.Com*)
Date: 11/12/04

```
Date: Thu, 11 Nov 2004 16:53:14 −0800
```

"john jardine" <john@jjdesigns.fsnet.co.uk> wrote in message
news:cmtilg$40p$1@news8.svr.pol.co.uk...
> *Indeed yes. Ohm can be pressed into service nicely, −if− we pretend the*
> *capacitor is a resistor having a fixed ohms value.*
> *This though applies only when dealing with particular AC circuitry and*
> *using*
> *en−masse pure sinewaves that have had no awkward beginnings and will have*
> *no*
> *awkward endings.*

Not true. But straightforward extension, you obtain the Laplace transform of your circuit (just replace all those 'j−omegas' with 's') and via convolution (multiplication in the s domain) you can find the output for relatively arbitrary input signals. The Laplace transforms for, e.g., step functions are quite 'reasonable' (not at all 'awkard').

This is done quite commonly.

> *But ... the capacitor as a component has ceased to exist, simplified to a*
> *linear impedance vector that can never accumulate/lose charge, or generate*
> *a*
> *current transient sufficient to cause fuses to blow. For calculating*
> *convenience, ohms law is being applied to a subset of special cases from*
> *the*
> *real world.*

Well, there's no such thing as an ideal capacitor anyway (and this fact become very significant at high frequencies), Ohm's law assume a 'lumped' network (no distributed effects −− this also becomes significant for many designers), Ohm's law comes from Maxwell's equations that are only an approximation of quantum electrodynamics (very significant to semiconductor guys), blah, blah, blah −−> very quickly this all becomes philosophical. Circuit simulators use components that are meant to _model_ 'reality,' but obviosuly the results are no good if your model isn't any good.

When doing a pure AC simulation, the net charge on the capacitor remains
unchanged so it'd be silly for an AC simulator to consider this. If you
want second by second charge, you'd use a transient analysis.

> *In Steve's post I read he was coming in from problems figuring through*
> *the*
> *initial startup transient. (ie ".TRAN").*
> *This messy aspect is usually glossed over but needed to account for the*
> *effects of reactive components in real circuitry.*

It's not that messy. A sine wave that starts at time 0 when applied to a
capacitor gets you a voltage that has an exponential term and the (same)
sine wave term; this comes directly from the inverse Laplace transform.
With a small source impedance, however, the exponential term decays very
quickly and can be neglected.

> *I'd think it would be a perverse person (masochist!) who would wish to*
> *characterise or transform the non linear curve of the initial capacitor*
> *charging current over maybe the first 1.5 cycles, into its near infinite*
> *number of component sinewaves and associated phase angles and then*
> *manipulate and sum each of these vectors to allow forcable time varying*
> *application of ohms law to all the reactive impedances.*

Again, this is undergraduate electrical circuit analysis. It isn't
difficult.

> *Basically I'm saying that Ohm shouldn't even be considered (my "ohms law*
> *doesn't apply"). Maybe considered only if some kind of steady (sinewave)*
> *state can exist. In many cases this will not occur or even be possible.*

The question is, "What do you want to know?" AC analysis is quite useful
for many circuit problems. So is transient analysis. Both can be performed
easily by hand so long as you stick with resistors, capacitors, and
inductors in your circuit. On the other hand, once you start sticking
non−linear active devices into the mix, you either decide you're operating
in the small signal domain and everything is still straightforward, or else
(for networks consisting or more than a few components) you end up trying to
solve differential equations which rapidly becomes intractable except via
numerical methods.

−−−Joel Kolstad